FINAL REPORT ON

ANTENNA TEST TRANSMITTERS

REPORT PERIOD 1 OCTOBER 1963 THROUGH COMPLETION

Prepared For

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INTRODUCTION

This is the final report on contract NAS8-11546, covering the design, development and delivery of three items of test transmitters. This report covers the period from 1 October 1963, the inception of the contract, through completion.

12p.

CONTENT

This report contains a summary of the work performed, as well as instructions for operation and maintenance of the equipment. The latter material is contained in three instruction manuals, REC-M-72, -73, and 74, which have been prepared especially for this equipment and which have been delivered previously.

In the interest of brevity, no attempt has been made to describe in great detail all avenues approached during the program; instead, only major efforts, milestones, and decisions are mentioned. As may be expected, the most persistent problem was the extremely short delivery schedule, requiring, in general, the use of what may be called the "brute force" approach to the solution of difficulties. These instances are not noted in the report, except as necessary for complete description of results.

PROGRAM SUMMARY

The work performed on the contract was divided into three parallel efforts, namely, the design, development and manufacture of each of the three items. These tasks are described separately in the paragraphs following.

UDOP Antenna Test Transmitter

Specification requirements for this device were as follows:

Frequency Coverage	890-960 mcs, continuous
Power Output	0-80 watts continuously variable
Frequency Stability	$\pm$ 0.01%
Output Impedance	50 ohms

Since the frequency range corresponded precisely with Resdel standard modules, these units were used throughout the transmitter; however, in order to achieve the required 80 watts output, it was necessary to use a pair of Resdel P-31E amplifier cavities, operating in parallel. The block diagram, Figure 1, shows how this parallel operation was implemented.

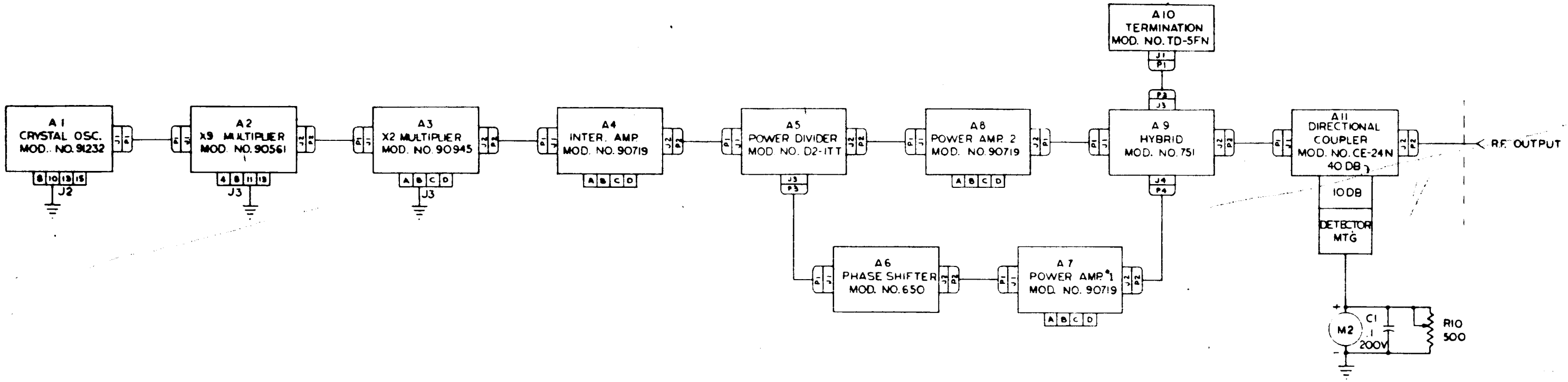

FIGURE 1 FUNCTIONAL BLOCK DIAGRAM

The driving signal, from the intermediate power amplifier was divided into two parts by means of a reactive power divider. One half of the signal drives a power amplifier directly while the other half passes through a variable phase shifter. This phase shifter, which is a folded "trombone", equalizes the phases of the outputs from the power amplifiers, so that addition is achieved into the proper output port of the hybrid. Considerable pruning of cables was required in this portion of the transmitter in obtaining proper operation over the frequency range.

In all other respects, the circuits used in the transmitter are conventional. Standard Resdel modules and commercial parts were used in all cases.

2000-2300 Mc Antenna Test Transmitter

Specification requirements for this device were as follows:

Frequency Coverage	2000-2300 mcs
Power Output	0-100 watts
Frequency Stability	$\pm$ 0.01%
Output Impedance	50 ohms

Preliminary investigations showed that the only power amplifier tube capable of stable operation at 100 watts output, and available for a reasonable price, was the Varian Type VA-802B four cavity klystron. Although this tube is rated to produce 1 kw output, it represents the most economical solution to the problem. Driver design is also much simplified, since this tube exhibits quite high power gain, typically about 35 db at this power output level. Accordingly, it was decided to use a high-order (X9) varactor frequency multiplier, in combination with the 225-260 mcs solid state driver being built for the VHF transmitter, to provide the required 2000-2300 mcs driving signal. However, some minor difficulties arose during the manufacture of the solid state units, causing a delay in their completion. Consequently, it was decided to build, instead, a three-tube driver producing two watts minimum in the 225 mcs region. This was accomplished in a relatively short time, and the unit operated satisfactorily as a driver for the X9 multiplier; however, with rather low efficiency.

No design or manufacturing difficulties were encountered with either the klystron amplifier or the high voltage power supply. The decision was made to use commercial broadcast type components in the power supply, including mercury vapor rectifier tubes, primarily because of economy, but secondarily because these components have proven the capability for long and reliable service in similar equipment in commercial service.

A 24" rack panel was chosen for this equipment in order to accommodate all components within a single rack. If the 19" panel had been used, two racks would have been required. Rack height was limited to 6'6" overall, so that the rack would fit through any standard doorway without tilting.

VHF Antenna Test Transmitter

Specification requirements for this device were as follows:

Number of Channels	5
Frequency Range	225-260 mcs
Power Output	0-200 watts/channel
Frequency Stability	± 0.01%
Output Impedance	50 ohms

In addition, means was to be provided for parallel operation of 2 to 5 channels, with suitable isolation between channels.

For this unit, a solid-state oscillator-frequency multiplier chain was designed, using a crystal oscillator in the 60 mcs region, followed by a X2 transistor frequency multiplier, three amplifier stages, and a varactor X2 frequency multiplier. These circuits were packaged in two modular enclosures, the combination producing about 2 watts RF output in the required frequency range.

A Resdel Model P-30A is used as the Intermediate Power Amplifier in each Exciter/Amp drawer. This device is capable of producing in excess of 20 watts output when driven by the solid state exciter.

The Power Amplifier in each Exciter/Amp chain is a grounded-grid stage using an RCA type 7650 Cermalox tetrode. This amplifier, designed especially for this application, produces in excess of 250 watts RF output in the frequency range, when driven by the combination mentioned above. Plate efficiency achieved was about 50%, which is adequate. It was not considered advisable to spend more time improving efficiency, considering the application.

The Multiplexer function is performed by a device purchased from Rantec Corporation, Calabasas, California, as a standard item. The unit consists of 5 channels, each channel comprising a 5 section filter. A low pass filter is contained in the common output line. Several shortcomings were noticed in this device, the most noticeable being insertion loss with consequent heating of the filters. This heating caused frequency drift in the multiplexer, requiring fairly lengthy warm-up time. Also, if any additional units were to be built using this device, it would be advisable to use a larger RF output connector, such as the HN or LT types. Additionally, some power might be conserved if the low-pass filter were eliminated.

Power supplies were, again, conventional, using commercial practices and components, as previously discussed. Purchased modular supplies were used wherever practicable.

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